IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Wolfgang ADERHOLD **Attorneys Docket:** AM-8304

Serial No.: 10/788,979 **Confirmation No.:** 6862

Filed: February 27, 2004 **Art Unit No.:** 3742

Examiner: S. Y. Paik

For: "BACKSIDE RAPID THERMAL PROCESSING OF PATTERNED WAFERS"

Commissioner for Patents
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 37 CFR §41.37

Sir:

This Appeal Brief is filed in support of the appeal of the above application dated December 12, 2010 and follows an appeal of substantially the same or even broader claims dated September 13, 2007.

(i) REAL PARTY IN INTEREST

The real party in interest in this appeal is the assignee, Applied Materials, Inc. of Santa Clara, California.

(ii) RELATED APPEALS AND INTERFERENCES

This application was previously appealed on September 13, 2007 and assigned Appeal 2009-003417, for which a Decision on Appeal issued on June 28, 20010. There are no other known appeals or interferences related to this application.

(iii) STATUS OF CLAIMS

Claims 6, 9 – 12, 10 – 11, 16 – 29 have been canceled. Claims 1 – 5, 7 – 8, 13 – 15, and 30 – 32 are pending and are all appealed.

(iv) STATUS OF AMENDMENTS

All amendments have been entered.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

<u>Claim 1</u>

The invention includes a method of rapid thermally processing (RTP) a wafer 12 in a fairly conventional RTP chamber, which is described at page 1, line 25 to page 4, line 3 with reference to the prior art of FIG. 1. The type of thermal processing is wide and can include annealing, crystallization, oxidation, chemical vapor deposition, and cleaning, as described at page 1, lines 13 – 15. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 underlies the outer portion of the wafer 12 on its unfeatured backside to support the wafer 12, which has its features 16 being developed in the RTP processing on its upwardly facing front side that is exposed to an array of radiant bulbs 26. Conventionally, pyrometers 40 have light pipes 42 facing the wafer backside to measure the temperatures at different radial portions of the wafer 12 to control the amount and distribution of radiant energy delivered to the wafer.

According to the invention of base method claim 1, as described at page 7, lines 16 – 21 with reference to FIG. 3, the wafer 12 is inverted to be disposed on a modified edge ring 64 with its unfeatured back side facing the radiant lamps 26. The edge ring 64 supports the front side of the wafer 12 having the features 16 being developed. As described at page 8, line 8, lines 22-24, the pyrometers 40 then directly monitor through light pipes 42 the temperature of the features (IC dies)16 being developed on the downwardly facing front side of the wafer 12. An advantage of the frontside pyrometry, as described at page 8, lines 22-24, is that the temperature of the developing integrated circuits is monitored rather than the back side of the wafer.

Claim 3

The invention of claim 3 similarly to claim 1 includes a method of rapid thermally processing (RTP) a wafer 12 in a fairly conventional RTP chamber, which is described at page 1, line 25 to page 4, line 3 with reference to the prior art of FIG. 1. The type of thermal processing is wide and can include annealing, crystallization, oxidation, chemical vapor deposition, and cleaning, as described at page 1, lines 13 – 15. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 underlies the outer portion of the wafer 12 on its unfeatured backside to support the wafer 12, which has its features 16 being developed in the RTP processing on its upwardly facing front side that is exposed to an array of radiant bulbs 26. Conventionally, pyrometers 40 have light pipes 42 facing the wafer backside to measure the temperatures at different radial portions of the wafer 12 to control the amount and distribution of radiant energy delivered to the wafer.

According to the invention of base method claim 3, as described at page 7, lines 16 – 19 with reference to FIG. 3, the wafer 12 is inverted to be disposed on a modified edge ring 64 with its unfeatured back side facing the radiant lamps 26. The front side of the wafer 12 with its features 16 is supported on an annular shelf 62 of the edge ring 64, as additionally illustrated in FIGS. 4 and 5. As described at page 4, lines 14 – 20 with reference to FIG. 2, rectangular integrated circuit dies 50 are developed only with the central portion of the wafer 12 and are not

developed in the edge exclusion zone 52 at the periphery of the wafer 12. As described at page 7, lines 19 – 30 with reference to FIGS. 4 and 5, the shelf 62 of the supporting edge ring 64 extends under the front side of the wafer 12 by a distance *V* with is less than the wafer edge exclusion zone 52. As described at page 8, line 8, lines 22-24, the pyrometers 40 then directly monitor through light pipes 42 the temperature of the features (IC dies)16 being developed on the downwardly facing front side of the wafer 12. The advantages of the narrow support within the exclusion zone include the reduction of particles described at page 9, lines 8 – 10 as well as the obvious advantage of not shielding otherwise good die areas.

Claim 8

The invention of claim 8 similarly to claim 1 includes a method of rapid thermally processing (RTP) a wafer 12 in a fairly conventional RTP chamber, which is described at page 1, line 25 to page 4, line 3 with reference to the prior art of FIG. 1. The type of thermal processing is wide and can include annealing, crystallization, oxidation, chemical vapor deposition, and cleaning, as described at page 1, lines 13 – 15. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 underlies the outer portion of the wafer 12 on its unfeatured backside to support the wafer 12, which has its features 16 being developed in the RTP processing on its upwardly facing front side that is exposed to an array of radiant bulbs 26. Conventionally, pyrometers 40 have light pipes 42 facing the wafer backside to measure the temperatures at different radial portions of the wafer 12 to control the amount and distribution of radiant energy delivered to the wafer.

According to the invention of base method claim 8, as described at page 2, lines 20 – 29, a reflector 28 faces the bottom of the wafer 12 and reflects heat radiation emitted from the wafer 12 back toward the wafer 12 to form a black body cavity at the back of the wafer 12. As described at page 7, lines 16 – 21 with reference to FIG. 3, the wafer 12 is inverted to be disposed on a modified edge ring 64 with its unfeatured back side facing the radiant lamps 26 and, as described at page 7, lines 29, 30, the patterned front side of the wafer faces downwardly

to the reflector 28. The advantages of placing the developing features within the black body cavity are described at page 8, lines 15 – 21.

Claim 13

The invention of claim 13 similarly to claim 1 includes a fairly conventional RTP chamber, which is described at page 1, line 25 to page 4, line 3 with reference to the prior art of FIG. 1. The type of thermal processing is wide and can include annealing, crystallization, oxidation, chemical vapor deposition, and cleaning, as described at page 1, lines 13 – 15. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 underlies the outer portion of the wafer 12 on its unfeatured backside to support the wafer 12, which has its features 16 being developed in the RTP processing on its upwardly facing front side that is exposed to an array of radiant bulbs 26. Conventionally, pyrometers 40 have light pipes 42 facing the wafer backside to measure the temperatures at different radial portions of the wafer 12 to control the amount and distribution of radiant energy delivered to the wafer.

According to the invention of base apparatus claim 13, as described at page 7, lines 16 – 19 with reference to FIG. 3, the wafer 12 is inverted so that its unfeatured back side faces the radiant lamps 26 and its front side of the wafer 12 with its downwardly facing features 16 is supported on holding means including an annular, such as a sloping annular shelf 62 of the edge ring 64. The edge ring is additionally illustrated in FIGS. 4 and 5 described at page 10, line 6 to page 11, line 4. The edge ring 64 of the described embodiment is modified so that it extends inwardly from the edge of the wafer 12 only a short distance and overlaps no more than the edge exclusion zone 52 of the wafer 12. The edge exclusion zone 52 is that outer peripheral area of the wafer not having features 16, that is, integrated circuits, formed in it. It is conventionally small, extending inwardly from the wafer edge by a distance of the order of 3 mm. As described at page 2, lines 20 – 29, a reflector 28 faces the bottom of the wafer 12 and reflects heat radiation emitted from the wafer 12 back toward the wafer 12 That heat originates from the radiant lamps 26. As described at page 7, lines 29, 30, the patterned front side of the wafer 12 faces

downwardly to the reflector 28. The advantages of placing the developing features within the black body cavity are described at page 8, lines 15 – 21.

According to the claim 13, as described at page 12, lines 2-17 with reference to FIG. 7, the inverted orientation of the wafer 12 allows holding means or a holding member 90 to support the wafer 12 in its inverted orientation from above on its back side. In the described embodiments implement the holding means or holding member 90 as either a pneumatic cup or an electrostatic chuck.

The inverted orientation of the wafer provides several processing advantages over the normal upwardly facing orientation as described at page 8, line 1 to page 9, line 10.

Claim 15

The invention of claim 15 similarly to claim 13 includes a fairly conventional RTP chamber, which is described at page 1, line 25 to page 4, line 3 with reference to the prior art of FIG. 1. The type of thermal processing is wide and can include annealing, crystallization, oxidation, chemical vapor deposition, and cleaning, as described at page 1, lines 13 – 15. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 underlies the outer portion of the wafer 12 on its unfeatured backside to support the wafer 12, which has its features 16 being developed in the RTP processing on its upwardly facing front side that is exposed to an array of radiant bulbs 26. Conventionally, pyrometers 40 have light pipes 42 facing the wafer backside to measure the temperatures at different radial portions of the wafer 12 to control the amount and distribution of radiant energy delivered to the wafer. According to the inventions of dependent claims 13 and 15, as described at page 12, lines 2-17 with reference to FIG. 7, the inverted orientation of the wafer 12 allows holding means or a holding member 90 to support the wafer 12 in its inverted orientation from above on its back side. In the described embodiments implement the holding means or holding member 90 as either a pneumatic cup or an electrostatic chuck.

According to the invention of base apparatus claim 32, as described at page 7, lines 16 –

19 with reference to FIG. 3, the wafer 12 is inverted so that its unfeatured back side faces the radiant lamps 26 and its front side of the wafer 12 with its downwardly facing features 16 is supported on holding means including an annular, such as a sloping annular shelf 62 of the edge ring 64. The edge ring is additionally illustrated in FIGS. 4 and 5 described at page 10, line 6 to page 11, line 4. As described at page 2, lines 20 – 29, a reflector 28 faces the bottom of the wafer 12 and reflects heat radiation emitted from the wafer 12 back toward the wafer 12 That heat originates from the radiant lamps 26. As described at page 7, lines 29, 30, the patterned front side of the wafer 12 faces downwardly to the reflector 28. The advantages of placing the developing features within the black body cavity are described at page 8, lines 15 – 21.

According to the invention of base apparatus claim 13, as described at page 7, lines 16 – 19 with reference to FIG. 3, the wafer 12 is inverted so that its unfeatured back side faces the radiant lamps 26 and its front side of the wafer 12 with its downwardly facing features 16 is supported on holding means including an annular ring. The edge ring is additionally illustrated in FIGS. 4 and 5 described at page 10, line 6 to page 11, line 4. As described at page 2, lines 20 – 29, a reflector 28 faces the bottom of the wafer 12 and reflects heat radiation emitted from the wafer 12 back toward the wafer 12 That heat originates from the radiant lamps 26. As described at page 7, lines 29, 30, the patterned front side of the wafer 12 faces downwardly to the reflector 28. The advantages of placing the developing features within the black body cavity are described at page 8, lines 15 – 21.

Additionally according to the invention of claim 15, as described at page 12, lines 2-17 with reference to FIG. 7, the inverted orientation of the wafer 12 allows holding means or a holding member 90 to support the wafer 12 in its inverted orientation from above on its back side. In the described embodiments implement the holding means or holding member 90 as either a pneumatic cup or an electrostatic chuck.

The inverted orientation of the wafer provides several processing advantages over the normal upwardly facing orientation as described at page 8, line 1 to page 9, line 10.

Claim 32

Claim 32 similarly to claim 13 includes a fairly conventional RTP chamber, which is described at page 1, line 25 to page 4, line 3 with reference to the prior art of FIG. 1. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 underlies the outer portion of the wafer 12 on its unfeatured backside to support the wafer 12, which has its features 16 being developed in the RTP processing on its upwardly facing front side that is exposed to an array of radiant bulbs 26.

According to the invention of base apparatus claim 32, as described at page 7, lines 16 – 19 with reference to FIG. 3, the wafer 12 is inverted so that its unfeatured back side faces the radiant lamps 26 and its front side of the wafer 12 with its downwardly facing features 16 is supported on holding means including an annular, such as a sloping annular shelf 62 of the edge ring 64. The edge ring is additionally illustrated in FIGS. 4 and 5 described at page 10, line 6 to page 11, line 4. As described at page 2, lines 20 – 29, a reflector 28 faces the bottom of the wafer 12 and reflects heat radiation emitted from the wafer 12 back toward the wafer 12 That heat originates from the radiant lamps 26. As described at page 7, lines 29, 30, the patterned front side of the wafer 12 faces downwardly to the reflector 28. The advantages of placing the developing features within the black body cavity are described at page 8, lines 15 – 21.

(vi) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1 and 2 are rejected under 35 U.S.C. §102(b) as being anticipated by Paranjpe (U.S. Patent 6,090,210).

Claims 3-5, 7, 8, 13-15, and 30-32 are rejected under 35 U.S.C. §103(a) as being obvious over Paranjpe in view of Moslehi (U.S. Patent 4,891,499), Ballance et al. (U.S. Patent 6,090,210), hereafter Ballance), or Anderson et al. (U.S. Patent 6,113,703, hereafter Anderson).

(vii) ARGUMENT

Claims 1 and 2

Claims 1 and 2 require the inversion of the substrate with its front side facing downwardly and its back side irradiated from an overhead radiant heat source. Claim 1 requires pyrometric monitoring of the substrate front side. It is noted that claim 2, though not separately argued, does not have proper antecedent basis in claim 1 and should instead recite a pyrometrically monitoring step.

Paranjpe in his general comments at col. 5, lines 52-54 states that: “While the pyrometer can be used to image the radiation from either surface of the wafer, higher accuracy can be obtained for the unpatterned backside.” Thereafter, Paranjpe describes his preferred embodiment of FIG. 2 including an inverted wafer 29 radiantly heated from the top and, contrary to claim 1, pyrometers 52 monitoring the unfeatured backside of the wafer 29. Note that Parnjepe illustrates thermal monitors 52 in FIG. 2 but never specifically references his pyrometers in col. 5, lines 5, lines 28-59.

Accordingly, Paranjpe teaches the unclaimed combination of backside pyrometric monitoring and topside irradiation of an inverted wafer. He further teaches against frontside pyrometric monitoring of a wafer of whatever orientation.

First, Paranjepe nowhere discloses in one place the combination of frontside pyrometric monitoring and topside irradiation of an inverted wafer. An “anticipatory reference [needs] to show all of the limitations of the claims arranged or combined in the same way as recited in the claims ...”, that is, “arranged or combined in the same way as in the claim.” *Net MoneyIN Inc. V. Verisign Inc.*, 88 USPQ2d 1751, 1758-1759 (Fed. Cir. 2008). Even though all elements are disclosed within “the four corners of a single, prior art document”, it is insufficient for anticipation if those elements are not “arranged as in the claim.” *ibid.* at 1758. Paranjepe discloses both (1) topside irradiation of the backside of inverted wafer, as required by the claim, and (2) the disfavored pyrometric monitoring of the backside of the wafer, as required by the claim. While Paranjape may be held to anticipate the bare claim to pyrometric monitoring of the

backside of the wafer, claim 1 further requires this feature to be combined with the topside irradiation of the inverted wafer. Paranjepe fails to teach the combination of the two features in a single embodiment and thus the anticipatory rejection must be removed.

Secondly, Paranjepe describes the disadvantage of frontside pyrometric monitoring and thus teaches against the claimed combination of frontside pyrometric monitoring and topside irradiation of an inverted wafer. Accordingly, even is this were a single-reference §103 rejection, Paranjepe teaches against the claimed combination, which is thus unobvious over the two separated descriptions of Paranjepe.

Claims 3-5

Paranjepe in his introductory remarks about pyrometry at col. 5, lines 52-55 suggests that it is possible to pyrometrically monitor the patterned front side of a wafer, but he immediately teaches against this configuration and instead describes his detailed embodiment as pyrometrically monitoring the unpatterned back side, as illustrated in FIG. 2. Accordingly Paranjaepe cannot be combined with the other references to teach the claimed combination of supporting the substrate within its edge exclusion zone with its patterned front side downwardly facing the radiant heat source and thermally monitoring the patterned front side. No reasonable mechanic in the art reading Paranjepe would follow his disfavored frontside pyrometric monitoring, as required by the thermal monitoring of claim 3.

Paranjepe does not describe his wafer support and his illustration of FIG. 2 can be considered schematic at best. Paranjepe thus fails to teach the claimed annular ledge for supporting his wafer.

Claim 3 has been somewhat narrowed over the previously appealed claim 3 to require that the annular shelf contact the substrate. The previous appeal board found the rejection of claim 3 to be improper over the same art excluding Parajepe but including another reference Moslehi ‘538. But since Paranjepe fails to disclose the annular ring or shelf, the board should simply reaffirm its previous finding of reversing the rejection of claims 3-7. Nonetheless, the

present rejection will be addressed in detail.

As noted in the second paragraph above, Paranjepe fails to disclose a wafer support including the claimed annular shelf.

Moslehi describes at col. 5, lines 54-64 an RTP chamber 10 illustrated in FIG. 2 in which the wafer 26 is supported by three pins 50 (col. 6, lines 57-61) with its back side facing overhead radiant lamps 24. Moslehi further describes at col. 5, line 65 to col. 6, line 42, two laser beams striking the unpatterned back side of the wafer 26 and the laser beams transmitted and reflected by the wafer 26 are detected by respective IR detectors 40, 42, 43, 45 to effect temperature measurement of the wafer. Moslehi's reflected laser beams 36,38 thermally monitor the unpatterned wafer back side and his transmitted laser beams 39, 41 thermally monitor the bulk of the wafer through they are transmitted. Accordingly, Moslehi fails to teach either thermal monitoring of the patterned front side, or a wafer support including an annular ledge, as required by claim 3.

Ballance illustrates in FIG. 1 a conventional RTP chamber 10 having an upwardly oriented wafer 15 with its features in its frontside (col. 1, line 21 and col. 4, line 15) exposed to an overhead radiant lamp head 40 including tungsten-halogen lamps 44. A support ring 18 includes an inwardly extending lip 24 which holds the wafer 16 on its backside (col. 4, lines 11-15). The only guidance to the extent of the lip 24 is that its leaves most of the wafer's backside exposed to a reflector plate 28 to form a reflector cavity (black body cavity) at the back of the wafer (col. 4, lines 25, 26). Ballance includes pyrometers 34 attached to light pipes 30 directed at the backside of the wafer 16 to monitor the backside wafer temperature and accordingly control the desired wafer temperature (col. 4, lines 25-39).

The claimed RTP chamber differs from that of Ballance by the inversion of the wafer and the details of the support ring useful for the inverted wafer. Ballance fails to suggest a narrow support ring having an annular shelf extending no more than the edge exclusion zone.

As Anderson illustrates in FIG. 2 and describes it at col. 4, lines 17-23, his wafer 12 is enclosed in a cavity formed between lower and upper heat plates 60, 62. Radiant lamps 18, 20

irradiate the heat plate 60, 62, which are opaque radiation (col. 4, lines 36-38). That is, the lamps 18, 20 do not irradiate the wafer 12 but instead heat the heat plates 60, 62, which form a black-body cavity or oven around the wafer 12. Pyrometers 22, 24 measure the temperature of the plates 60, 60 (col. 4, lines 47, 48), not the temperature of the wafer 12. The claimed radiant heat source corresponds to Anderson's radiant lamps 18, 20. Claim 3 requires that the substrate back side faces the radiant heat source. In contrast, Anderson's wafer back side faces the lower heat plate 60, itself heated by the lower radiant heat source 18, 20.

Anderson supports his wafer on discrete wafer seats 58 extending from a number of arms 55, as described at col. 3, lines 57-62. The seats 58 are illustrated in FIGS. 2-4 as pointed pins inside of separate sloping centering surfaces. Such does not constitute the claimed annular ledge. Anderson's limited number of discrete pins and centering surfaces forms neither an annular ring nor an annular ledge.

Claim 3 also requires either thermal monitoring of the front side of the substrate. In contrast, Anderson pyrometrically monitors both the outer surfaces of the lower and upper heat plates 60, 62 enclosing his wafer. "Pyrometers 24 and 22 measure the temperature of plates 60 and 62, respectively and generate signals in response to the measured temperatures." (col. 4, lines 47-49). Anderson's pyrometers do not measure the temperature of the wafer but instead measures the temperatures of the outer surface of the heat plates 60, 62, which do not necessarily correspond to the temperature of the wafer enclosed by the heat plates, particularly during the rapid heat up and cool down phase characteristic of RTP.

Only Ballance and Paranjepe describe pyrometric monitoring of the wafer. However, Ballance and Paranjepe in the latter's sole described complete embodiment direct their pyrometers to the unfeatured back side of the wafer while claim 3 requires thermal monitoring of the substrate front side. Moslehi thermally monitors either the unfeatured back side or the bulk of the wafer. Anderson pyrometrically monitors his heat plates, not the wafer.

The examiner may allege that Moslehi teaches the inverted orientation, which could possibly be applied to the Ballance's or Anderson's chamber. However, the examiner is not free

to pick and choose different parts of multiple references without some reason for making the combination. If Ballance teaches backside pyrometry on a frontside-up wafer and Moslehi teaches backside pyrometry on a frontside-down wafer, then the ordinary mechanic must conclude that backside pyrometry is the only preference in the art (as is reinforced by Paranjepe) so that the support system and overhead pyrometers of Moslehi should be used for processing a frontside-down wafer. It is only in unpermitted hindsight that the wafer of Ballance is inverted following Moslehi but the chamber structure of Moslehi is ignored.

None of the art discloses supporting the substrate on a peripheral ring within an edge exclusion zone or even of the importance of supporting it within a narrow peripheral region. Moslehi's and Anderson's pin support apparently is willing to sacrifice three peripheral dies. Paranjepe seems unconcerned with a narrow support of the inverted wafer. Ballance's ring supports the unpatterned back side, so its lateral extent is not critical, and is illustrated to have a significant lateral extent.

<u>Claim 8</u>

Claim 8 requires that the downwardly oriented wafer front side face a reflector. As a reulst, the reflector forms a blackbody cavity adjacent the wafer front side. Paranjepe fails to disclose a reflector. Moslehi may have a suitable geometry for this exposure of the wafer front side but he fails to disclose that his chambers have a reflector providing such a blackbody cavity. Ballance's chamber forms a blackbody cavity but it is formed adjacent the wafer backside, not the claimed front side. Anderson's blackbody cavity is formed by his two enclosing opaque heat plates 60, 62 and is not formed by a reflector. The applied art fails to disclose exposing the wafer front side to a blackbody cavity formed by a reflector or to disclose that there is any benefit to doing so.

The ordinary mechanic in viewing the combination of applied references needs to more consider the function performed by the elements in achieving the desired wafer processing rather than the available structure that may be used for a previously undisclosed process. The applied

art teaches placing a blackbody cavity on the wafer back side, not its front side. Accordingly, claim 8 and its dependent claims should be held allowable.

Claim 8 additionally requires pyrometric monitoring the front side of the substrate. This is more particular than the thermal monitoring of claim 3. Moselhi's lasers do not perform pyrometric monitoring as that term is understood in the art and as is used by Paranjepe, Moslehi, and Ballance.

Most of the arguments presented for claim 3 apply as well to claim 8. A broader claim 8 has been found patentable in the prior appeal and the added reference to Paranjepe does not overcome the non-obviousness of the combination of radiant heating of the back side of an inverted wafer and pyrometric monitoring of the front side.

Claim 13

Claim 13 requires both that the downwardly facing wafer front side face a reflector, as in claim 8, but also that the wafer front side be supported within its edge exclusion zone by an annular ring. As argued above for claim 3, no art shows supporting the wafer back side on an annular ring and the requirement of the edge exclusion zone introduces a further limitation not suggested in the art.

More directly, the rejection of claims substantially the same as these claims was reversed by the BPAI in the former appeal over the same art excluding Paranjepe. It is noted that these claims do not recite the pyrometric monitoring for which the examiner invokes the added reference of Paranjepe. Paranjepe fails to disclose either a reflector or a support extending only within an edge exclusion zone of the wafer and so is really immaterial to claims 13 and 14. Accordingly, the rejection of these claims should continued to be reversed despite the addition of Paranjepe.

Claim 15

Claim 15, which follows claim 13 except for the edge exclusion zone, additionally

requires a detachable holding means for holding the wafer from its top. Paranjepe and Moslehi are silent as to the means they use for putting their frontside-down wafer in its processing position. No art has been cited for the claimed feature, no *prima facie* case of obviousness has been established, and the claim must accordingly be held allowable.

Claims 31 and 32

Claims 31 and 32, which are respectively dependent upon claim 3 and independent, require that the shelf or ring supporting the wafer front side includes a sloping shelf. The examiner cites Anderson for this feature. Anderson briefly describes his wafer support at col. 3, lines 56-65 with reference to FIG. 2. He states that the "wafer holder arms 55 terminate in discrete wafer seats 58." Discrete seats means multiple, probably three seats separate from each other, not an annular ring or shelf. The small circumferential extent of Anderson's seats 58 are insufficient to interfere with gas flow (col. 5, lines 40-43). Further, as can be best interpreted from FIG. 2, each seat 58 includes a inwardly sloping portion which acts as a means for centering the wafer 12 and also includes a sharp point in contact with the bottom back side of the wafer 12. Such a structure does not satisfy the recitation of claim 3 of an annular shelf extending under the substrate of the recitation of claim 12 of an annular. In any case, Anderson is teaching the support of the wafer backside, not the support of the wafer frontside. His illustrated support with sharp points extending far inside of the wafer edge is clearly inapplicable to supporting the front side of a wafer, as required by claims 31 and 32.

The newly added reference to Paranjepe fails to supply the limitation of a support ring with a sloping annular shelf and the other references have been found in the prior appeal to not bar patentability.

(9) CONCLUSION

Accordingly, base claims 1, 3, 8, 13, 15, and 32 and all claims dependent therefrom should be held allowable. Dependent claims 4 and 31should be held additionally allowable. The Board is respectfully requested to reverse the rejections and return the case for a second time to the Examiner for allowance.

Respectfully submitted,

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(viii) CLAIMS APPENDIX

1. A method of thermally processing a substrate in a reactor comprising a radiant heat source, comprising the steps of:

disposing a substrate to be thermally processed on a front side thereof facing downwardly to form features therein with a back side opposite said front side facing said radiant heat source; and

pyrometrically monitoring including receiving radiation radiantly emitted from said front side of said substrate.

2. The method of claim 1, wherein said thermally monitoring step includes measuring temperatures at a plurality of radial positions relative to a center of said substrate.

3. A method of thermally processing a substrate in a reactor comprising a radiant heat source, comprising the steps of:

disposing a substrate to be thermally processed on a front side thereof to form features therein with a back side opposite said front side facing said radiant heat source, wherein said disposing includes supporting said substrate with a peripheral fixture including an annular shelf contacting the substrate and extending under the substrate around its center but no further inward than an edge exclusion zone of said substrate; and

thermally monitoring said front side of said substrate.

4. The method of claim 3, wherein said edge exclusion zone has a width of no more than 3mm.

5. The method of claim 3, wherein said substrate is disposed with said front side facing downwardly.

7. The method of claim 1, further comprising reflecting heat emitted from said front side of said substrate back to said front side across a radiation cavity.

8. A method of thermally processing a substrate in a reactor comprising a radiant heat source in opposition to a reflector extending parallel to a surface of said substrate and facing said surface over substantially all of said substrate, comprising the steps of:

disposing a substrate to be thermally processed on a front side to form features therein with said front side facing downwardly and towards said reflector and a back side of said substrate opposite said front side facing said radiant heat source, whereby said reflector reflects radiant energy produced in said substrate by said radiant heat source and emitted from said front side back to said front side; and

pyrometrically monitoring a plurality of positions on said front side including receiving radiation radiantly emitted from the plurality of positions.

13. A thermal processing apparatus, comprising:

a radiant heat source for directing radiant energy downwardly;

means including an annular ring for holding a wafer on an annular surface of the annular ring and with a back side of the wafer facing said radiant heat source, a front side of said wafer opposite said back side being processible in said thermal processing apparatus to form features on said front side, wherein said holding means overlaps said front side only within an edge exclusion zone of said wafer; and

a reflector disposed on a downward side of said wafer to reflect back to said front side radiation produced by said radiant heat source and emitted from said front side, wherein said radiant heat source is disposed above said reflector.

14. The apparatus of claim 13, wherein said edge exclusion zone extends no further than 3mm from an edge of said wafer.

15. A thermal processing apparatus, comprising:

a radiant heat source for directing radiant energy downwardly;

means including an annular ring for holding a wafer with a back side thereof facing said radiant heat source, a front side of said wafer opposite said back side being processible in said thermal processing apparatus to form features on said front side;

a detachable holding member capable of holding said wafer from a top side thereof; and

a reflector disposed on a downward side of said wafer to reflect back to said front side radiation produced by said radiant heat source and emitted from said front side, wherein said radiant heat source is disposed above said reflector.

30. The method of claim 3, wherein the step of thermally monitoring includes pyrometry including receiving radiation thermally emitted from the front side.

31. The method of claim 3, wherein the shelf is a sloping shelf.

32. A thermal processing apparatus, comprising:

a radiant heat source for directing radiant energy downwardly;

means including an annular ring for holding a wafer with a back side thereof facing said radiant heat source, a front side of said wafer opposite said back side being processible in said thermal processing apparatus to form features on said front side, wherein the ring includes a sloping annular shelf for supporting the wafer; and

a reflector disposed on a downward side of said wafer to reflect back to said front side radiation produced by said radiant heat source and emitted from said front side, wherein said radiant heat source is disposed above said reflector.

(ix) EVIDENCE APPENDIX

NONE

There is no evidence other than the cited and applied prior art references submitted to date in this appeal.

(X) RELATED PROCEEDINGS APPENDIX

The decision of the prior appeal 2009-003417 is available on PAIRS in document dated 28 June 2010 for the present application. There are no other known related proceedings and hence there are no other decisions available for such proceedings.